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SHINYEI.

最終頁に続く

(54)【発明の名称】　花粉検出器　Pollen Detecting Device.

(57)【特許請求の範囲】

【請求項１】　空中の浮遊粒子のうち花粉粒子のみを検出する花粉検出器であって．所定方向に偏光した入射光を前記浮遊粒子に照射する偏光光源部と、前記浮遊粒子による散乱光を受光して該浮遊粒子の粒子径を表す信号を出力する散乱光強度測定部と、前記散乱光を受光して該散乱光の偏光解消度を表す信号を出力する偏光解消度測定手段と、前記偏光解消度を表す信号と前記粒子径を表す信号とに基づいて、粒子径が所定範囲内にあり且つ偏光解消度が所定値より大きい浮遊粒子を花粉粒子として検出する判別手段とを備えたことを特徴とする花粉検出器。

【請求項２】　空中の浮遊粒子のうち花粉粒子のみを検出する花粉検出器であって．空中に浮遊する直径約１００μm以上の粒子を予め除去するフィルターと．所定方向に偏光した入射光を前記フィルター通過後の浮遊粒子に照射する偏光光源部と．前記フィルター通過後の浮遊粒子による散乱光を受光して該散乱光の偏光解消度を表す信号を出力する偏光解消度測定手段と、前記偏光解消度を表す信号に基づいて．偏光解消度が所定値より大きい浮遊粒子を花粉粒子として検出する判別手段とを備えたことを特徴とする花粉検出器。

【請求項３】　前記偏光解消度測定手段は、前記散乱光のうち前方散乱光の前記入射光の偏光方向と同じ方向の偏光強度と、前記散乱光のうち側方散乱光の前記入射光の偏光方向に直交する方向の偏光強度とに基づいて、前記偏光解消度を表すデータを出力することを特徴とする請求項１又は２記載の花粉検出器。

【請求項４】　前記偏光解消度測定手段は、前記散乱光のうち側方散乱光の前記入射光の偏光方向に直交する方

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CLAIMS

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(57) [Claim(s)]

[Claim 1] The pollen detector which detects only a pollen grain child among the airborne particulates characterized by providing the following. The polarization light source section which irradiates the incident light which polarized in the predetermined direction at the aforementioned suspended particle. The scattered-light on-the-strength test section which outputs the signal with which the scattered light by the aforementioned suspended particle is received, and the particle diameter of this suspended particle is expressed. A degree-of-depolarization measurement means to output the signal with which the aforementioned scattered light is received and the degree of depolarization of this scattered light is expressed. A distinction means by which a particle diameter is in predetermined within the limits, and degree of depolarization detects a larger suspended particle than a predetermined value as a pollen grain child based on the signal showing the aforementioned degree of depolarization, and the signal showing the aforementioned particle diameter.

[Claim 2] The pollen detector which detects only a pollen grain child among the airborne particulates characterized by providing the following. The filter from which a particle with a diameter of about 100 micrometers or more which floats in the air is removed beforehand. The polarization light source section which irradiates the incident light which polarized in the predetermined direction at the suspended particle after the aforementioned filter passage. A degree-of-depolarization measurement means to output the signal with which the scattered light by the suspended particle after the aforementioned filter passage is received, and the degree of depolarization of this scattered light is expressed. A distinction means by which degree of depolarization detects a larger suspended particle than a predetermined value as a pollen grain child based on the signal showing the aforementioned degree of depolarization.

[Claim 3] the aforementioned degree-of-depolarization measurement means -- the inside of the aforementioned scattered light -- the same polarization intensity of a direction as the polarization direction of the aforementioned incident light of forward-scattering light, and the inside of the aforementioned scattered light -- the side -- the pollen detector according to claim 1 or 2 characterized by outputting the data showing the aforementioned degree of depolarization based on the polarization intensity of the direction which intersects perpendicularly in the polarization direction of the aforementioned incident light of the scattered light

[Claim 4] the aforementioned degree-of-depolarization measurement means -- the inside of the aforementioned scattered light -- the side -- the pollen detector according to claim 1 or 2 characterized by outputting the data showing the aforementioned degree of depolarization based on the polarization intensity of the direction which intersects perpendicularly in the polarization direction of the aforementioned incident light of the scattered light

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the pollen detector used for detection of the pollen grain child who floats in the atmosphere leading to pollinosis.

[0002]

[Description of the Prior Art] Conventionally, counting of the pollen which floats in the atmosphere was performed by the method in which exposes a glass plate into the atmosphere, and carries out dyeing processing of the pollen adhering to this, and a skillful person does counting visually using a microscope.

[0003]

[Problem(s) to be Solved by the Invention] however, in pretreatment time-consuming [of dyeing] taking much time by the above-mentioned method -- viewing -- advanced skill is required of those who perform counting Moreover, in order to have to expose a glass plate into the fixed time atmosphere, there is a trouble that pollen is undetectable on real time. Furthermore, there is a trouble that a measurement result cannot be obtained in the place which should be measured.

[0004] this invention solves such a trouble and the purpose of this invention is offering the pollen detector which can moreover carry out pollen counting on real time in the place which should be measured, without requiring special skill.

[0005]

[Means for Solving the Problem] The polarization light source section which the pollen detector concerning this invention is a pollen detector which detects only a pollen grain child among airborne particulates, and irradiates the incident light which polarized in the predetermined direction at the aforementioned suspended particle, The scattered-light on-the-strength test section which outputs the signal with which the scattered light by the aforementioned suspended particle is received, and the particle diameter of this suspended particle is expressed, A degree-of-depolarization measurement means to output the signal with which the aforementioned scattered light is received and the degree of depolarization of this scattered light is expressed, It is characterized by having a distinction means by which a particle diameter is in predetermined within the limits, and degree of depolarization detects a larger suspended particle than a predetermined value as a pollen grain child, based on the signal showing the aforementioned degree of depolarization, and the signal showing the aforementioned particle diameter.

[0006] Moreover, the filter from which a particle with a diameter of about 100 micrometers or more which the pollen detector of this invention is a pollen detector which detects only a pollen grain child among airborne particulates, and floats in the air is removed beforehand, The polarization light source section which irradiates the incident light which polarized in the predetermined direction at the suspended particle after the aforementioned filter passage, A degree-of-depolarization measurement means to output the signal with which the scattered light by the suspended particle after the aforementioned filter passage is received, and the degree of depolarization of this scattered light is expressed, It is characterized by having a distinction means by which degree of depolarization detects a larger suspended particle than a predetermined value as a pollen grain child, based on the signal showing the aforementioned degree of depolarization.

[0007] moreover, the two above-mentioned composition -- setting -- the aforementioned degree-of-depolarization measurement means -- the inside of the aforementioned scattered light -- the same polarization intensity of a direction as the polarization direction of the aforementioned incident light

of forward-scattering light, and the inside of the aforementioned scattered light -- the side -- based on the polarization intensity of the direction which intersects perpendicularly in the polarization direction of the aforementioned incident light of the scattered light, it can also consider as the composition which outputs the data showing the aforementioned degree of depolarization
[0008] furthermore, the two above-mentioned composition -- setting -- the aforementioned degree-of-depolarization measurement means -- the inside of the aforementioned scattered light -- the side -- based on the polarization intensity of the direction which intersects perpendicularly in the polarization direction of the aforementioned incident light of the scattered light, it can also consider as the composition which outputs the data showing the aforementioned degree of depolarization
[0009] in addition, the scattered light which goes straight on in the extended direction of an incident-light shaft with forward-scattering light in this specification -- the side -- the scattered light shall mean the scattered lights other than forward-scattering light
[0010] this invention is based on the thing large more remarkably than that of other suspended particles in which a depolarization operation of the scattered light by the pollen grain child in the atmosphere has the same particle diameter as a pollen grain child. Here, the degree of depolarization of the scattered light expresses the degree to which the degree of polarization of the scattered light falls to the degree of polarization of an incident light, when the incident light which polarized in the predetermined direction is irradiated by pollen and scattered about. When an incident light is the linearly polarized light (the polarization direction is hereafter called "incidence polarization direction"), the degree of depolarization of the scattered light is expressed by the ratio of the polarization intensity in the direction which intersects perpendicularly in the incidence polarization direction of the scattered light to the polarization intensity in the same direction as the incidence polarization direction of the scattered light.
[0011] the case where degree of depolarization generally measures about forward-scattering light -- the side -- it measured about the scattered light, and it is [direction] large and becomes an incident-light shaft with the maximum in a right-angled direction the side -- degree of depolarization -- the side -- the side to the polarization intensity of the incidence polarization direction of the scattered light -- it is expressed with the ratio of the polarization intensity of the right-angled direction in the incidence polarization direction of the scattered light however -- expedient -- polarization intensity Ipar of the incidence polarization direction of forward-scattering light the receiving side -- polarization intensity Iver of the direction which intersects perpendicularly in the incidence polarization direction of the scattered light a ratio -- Iver/Ipar It can express. this specification -- setting -- the case of the latter -- including -- the side -- it shall be called degree of depolarization Iver/Ipar of a pollen grain child and other suspended particles if a value is compared -- the side of pollen -- degree of depolarization is about about 5 times of that of other suspended particles Moreover, when an incident light is the linearly polarized light, degree of depolarization can be known only with right-angled polarization intensity in the incidence polarization direction included in the scattered light.
[0012] When a big particle exists, it becomes impossible moreover, to detect a pollen grain child in measurement of only degree of depolarization, since degree of depolarization generally also becomes large so that a particle diameter becomes large. However, since the particle diameter of pollen is smaller than other suspended particles which have degree of depolarization of the same grade as pollen and the distribution is narrow, it becomes possible by asking for a particle diameter from scattered-light intensity simultaneously with degree of depolarization to detect only a pollen grain child. That is, degree of depolarization is large and it becomes possible to detect only a pollen grain child by detecting the particle which has a particle diameter in predetermined within the limits.
[0013] The principle of this invention is shown in drawing 5 . The polarization light source section which emits the incident light which polarized is constituted by the general light source 1 and a general polarizing element 3, and the light which passed the polarizing element 3 is polarizing in the perpendicular direction. In drawing 5 , the arrow of a solid line expresses the polarization direction of light, and the arrow of a dashed line expresses the polarization shaft orientation of a polarizing element, respectively. It is condensed by the predetermined position with a lens 2, and these polarization beams of light are scattered about by the suspended particle 10 which passes through this position.
[0014] the side scattered about in the direction right-angled on an incident-light shaft among the scattered lights -- the scattered light reaches a photo detector 6 through a polarizing element 4 and a lens 5 The polarization shaft of a polarizing element 4 is set up in the right-angled direction with it of

a polarizing element 3. therefore, the photo detector 6 -- the side -- the incidence polarization direction of the scattered light -- polarization intensity Iver of the right-angled direction It is obtained.

[0015] On the other hand, the forward-scattering light scattered about on extension of an incident-light shaft among the scattered lights reaches a photo detector 9 through a polarizing element 7 and a lens 8. The polarization shaft of a polarizing element 7 is set up in it of a polarizing element 3, and this direction. Therefore, it is the polarization intensity Ipar of the incidence polarization direction of forward-scattering light by the photo detector 9. It is obtained. Iver obtained above Ipar the side -- degree-of-depolarization Iver/Ipar It can obtain. Moreover, it is Iver when an incident light is the linearly polarized light. The size of a depolarization operation can also be known.

[0016] Furthermore, since forward-scattering light intensity also becomes large so that a particle diameter is large, the size of a particle can be known by measurement of forward-scattering light intensity. therefore, the side -- degree-of-depolarization Iver/Ipar It is beyond a predetermined value and a pollen grain child can be discriminated by detecting the suspended particle which has forward-scattering light intensity in predetermined within the limits. Moreover, it is Ipar, so that forward-scattering light intensity is large. Since it becomes large, it replaces with forward-scattering light intensity, and it is Ipar. The size of a particle can be known even if it uses.

[0017] moreover, the thing for which the filter removes beforehand the suspended particle with a large particle diameter and large degree of depolarization -- the side -- a pollen grain child is discriminable with measurement of only degree of depolarization

[0018]

[Function] If a suspended particle exists in the light as an electromagnetic wave, a suspended particle will be polarized in the oscillating direction of electric field, and an electric dipole will be formed. The direction of this polarization is greatly influenced by the anisotropy of a particle. Since the direction of polarization of an isotropic-substance-particle becomes equal to the incidence polarization direction, the polarization direction of the light which is scattered about and comes out is equal to the incidence polarization direction.

[0019] However, compared with the particle which has an anisotropy, and the wavelength of an incident light, the direction of polarization is determined by the polarization tensor peculiar to a particle by the particle with the big path. Since the anisotropy is large compared with the suspended particle in the air of others [particle / like pollen], when the incident lights of the linearly polarized light are scattered about by the pollen grain child, the scattered light will contain a polarization component right-angled in the incidence polarization direction. such a polarization component of the right-angled direction -- an incident-light shaft -- receiving -- the 90-degree side -- it becomes the maximum by the scattered light

[0020] The histogram with which the particle size distribution of the suspended particle in the atmosphere are expressed to drawing 6 is shown. As shown in the slash section of this drawing, the distribution is concentrating the particle diameter of pollen on the range of 20-50 micrometers. For example, in Japan cedar pollen, 30-40 micrometers and the Alnus pendula pollen have the 20-30-micrometer particle diameter. On the other hand, sedimentation nature air dust and fly ASHU have the distribution which carries out monotonous reduction. As mentioned above, it is the polarization intensity Ipar of the incidence polarization direction of forward-scattering light, so that a particle diameter is large. Since it becomes large, it is Ipar about the horizontal axis of drawing 6 . It is the same even if it replaces. Therefore, drawing 6 to Ipar It turns out that pollen, sedimentation nature air dust, and fly ASHU are undistinguishable only using information.

[0021] however, it is shown in drawing 7 -- as -- the side -- degree-of-depolarization Iver/Ipar If it takes on a horizontal axis, it becomes a different distribution from pollen, sedimentation nature air dust, and fly ASHU, and detection of pollen is possible except for the duplication section S of a distribution. The duplication section S is the overlapping portion of the portion by the comparatively small Japan cedar pollen of degree of depolarization etc., and the portion by the big particle 100 micrometers or more of the sedimentation nature air dust also in pollen. Therefore, in this duplication section S, when a big particle 100 micrometers or more is removed, it turns out that only pollen is detectable. drawing 8 -- polarization intensity Ipar of the incidence polarization direction of forward-scattering light a horizontal axis -- the side -- degree-of-depolarization Iver/Ipar The distribution with the pollen at the time of taking on a vertical axis and sedimentation nature air dust is shown. This drawing shows that pollen and sedimentation nature air dust are clearly distinguishable.

[0022] this invention -- the side -- polarization intensity Ipar of the incidence polarization direction of degree of depolarization, forward-scattering light, or forward-scattering light By measuring, degree of depolarization has detected the particle in within the limits whose particle diameter is 20-50 micrometers as a pollen grain child or more by 0.3.

[0023] furthermore, the **** particle diameter which removes a particle 100 micrometers or more with a filter beforehand -- it is not necessary to ask -- becoming -- the side -- pollen is also detectable with measurement of only degree of depolarization the case where an incident light is the linearly polarized light -- the side -- measurement of only polarization intensity right-angled, in the incidence polarization direction of the scattered light -- the side -- the size of a depolarization operation can be known

[0024]

[Example] Hereafter, the example of this invention is further explained to a detail based on a drawing. Drawing 1 shows the flat-surface composition of the pollen detector concerning one example of this invention, and drawing 2 shows the P-P line cross section of drawing 1 . the polarization light source section 26 which irradiates the incident light which the pollen detector of this example was formed in housing 25, and polarized in the predetermined direction at a suspended particle, the front polarimetry section 27 which measures the polarization intensity of the forward-scattering light by the suspended particle, and the side by the suspended particle -- the side which measures the polarization intensity of the scattered light -- it has the polarimetry section 28 the maximum degree of depolarization is obtained in this example -- as -- the side -- although it set up so that the scattered light of the direction which intersects the polarimetry section 28 perpendicularly with an incident-light shaft might be measured, it is also possible to set it as other arbitrary angles

[0025] The inhalation mouth 21 is formed in the base of housing 15, and heaters 22 and 23 are formed in the side of the inhalation mouth 21. An ascending current arises with the heat of heaters 22 and 23, and sample air is supplied by this in housing 25. Therefore, sample air will be supplied toward the upper part of space from the space lower part of drawing 1 . In this example, the rate of flow of sample air was 180mm/second.

[0026] The polarization light source section 26 is constituted by the red light emitting diode (Toshiba; TLOA180AP) 11, the polarizing filter (; by the Polaroid company HN38) 13 which set up the polarization shaft in the direction perpendicular to the space of drawing 1 , and the plastic lens 12 with a focal distance of f= 10mm. The lens 2 is set up so that the detecting point F may be made to condense the light which penetrated the polarizing filter 3.

[0027] The front polarimetry section 27 is constituted by the optical trap 24 which cuts the light which carries out direct incidence from the outside, the polarizing filter (; by the Polaroid company HN38) 17, the plastic lens 18 with a focal distance of f= 10mm, and the photo transistor (made in Stanley-D 101) 19 for detecting the transmitted light of a polarizing filter 17. The polarization shaft of a polarizing filter 17 is set up in the direction perpendicular to the space of drawing 1 like the polarizing filter 13.

[0028] the side -- the polarimetry section 28 is constituted by the polarizing filter (; by the Polaroid company HN38) 14, the plastic lens 15 with a focal distance of f= 10mm, and the photo transistor (made in Stanley-D 101) 16 for detecting the transmitted light of a polarizing filter 14 The polarization shaft of a polarizing filter 14 is set up so that it may become right-angled to the polarization shaft of a polarizing filter 13, namely, so that it may become parallel to the space of drawing 1 .

[0029] in addition -- this example -- a scattered-light on-the-strength test section -- the front polarimetry section 27 -- corresponding -- **** -- a degree-of-depolarization measurement means -- the side -- it corresponds to the polarimetry section 28

[0030] In the pollen detector of this example, only the component which has the polarization direction perpendicular to the space of drawing 1 among the light emitted from the red light emitting diode 11 of the polarization light source section 26 penetrates a polarizing filter 13. The light which penetrated the polarizing filter 13 condenses at the detecting point F, after penetrating a lens 12. Sample air is supplied to the detecting point F by the air current which heaters 22 and 23 cause. Passage of the detecting point F of the suspended particle contained in this sample air scatters the polarization which condensed.

[0031] The forward-scattering light scattered on the travelling direction of an incident light among the scattered lights penetrates the optical trap 24 of the front polarimetry section 27, and reaches a polarizing filter 17 further. In a polarizing filter 17, the incidence polarization direction produced by depolarization operation of a suspended particle and a right-angled polarization component are cut, and only polarization of the same direction as the incidence polarization direction reaches a photo transistor 19. Thereby, a photo transistor 19 outputs photo-electric-translation signal Sig.2.

[0032] the side scattered about in the direction right-angled to the travelling direction of an incident light on the other hand -- the incidence polarization direction among the scattered lights, and a right-angled polarization component -- the side -- the polarizing filter 14 of the polarimetry section 28 is penetrated, and a photo transistor 16 is reached Thereby, a photo transistor 16 outputs photo-electric-translation signal Sig.1.

[0033] Photo-electric-translation signal Sig.1 outputted from photo transistors 16 and 19, respectively and Sig.2 are processed in a distinction circuit as shown in drawing 3 . Suppose that photo-electric-translation signal Sig.2 shown in drawing 4 (a) and (b), respectively and Sig.1 were obtained in this example. In drawing 4 (a) and (b), each of a pulse-like signal corresponds to one suspended particle.

[0034] photo-electric-translation signal Sig.1 shown in drawing 4 (b) -- the side -- the degree of depolarization in the scattered light -- expressing -- **** -- this photo-electric-translation signal Sig. -- 1V3 What becomes the above corresponds to the suspended particle which has a particle diameter 100 micrometers or more with a pollen grain child. Sig.1 inputted into AMP2 as shown in drawing 3 is V3. When large, it is a transistor Q1. And Q2 Sample offering voltage Vs AMP1 is supplied. Thereby, AMP1 will be in on state.

[0035] since AMP1 outputs Sig.2 to A points as they are in the state of on, it is shown in (c) of drawing 4 -- as -- A points -- the side -- only photo-electric-translation signal Sig.2 about a particle with the large degree of depolarization of the scattered light appear

[0036] Photo-electric-translation signal Sig.2 are the polarization intensity Ipar of the same direction as the polarization direction of an incident light among forward-scattering light. It expresses and is this Ipar. It corresponds to the size of a particle diameter. Q3 of drawing 3 And Q4 Sig.2 are V1. Only when it is the following, it functions as making AMP3 into on state, and AMP3 is V2 in on state. Sig.2 [large] are outputted to the B point. Therefore, V1 V2 By setting it as a suitable value, only the suspended particle of the particle diameter of the predetermined range is detectable. this shows drawing 4 (d) -- as -- the B point of drawing 3 -- the side -- the degree of depolarization of the scattered light is larger than a predetermined value, and only the suspended particle which has a particle diameter in predetermined within the limits is detected as a pollen grain child

[0037] Counting of the pulse signal which appeared in the B point is carried out at a counter 30, and it is displayed on a display 31. In addition, the distinction circuit and display 31 of drawing 3 are prepared in the panel section 20 shown in drawing 1 .

[0038] in addition -- this example -- degree of depolarization -- forward-scattering light and the side -- although asked by the scattered light -- forward-scattering light -- or the side -- it can also ask only using the scattered light in this case, forward-scattering light or the side -- if the scattered light is divided into the polarization component which intersects perpendicularly by polarization beam splitters, such as a Wollaston prism, it can ask for degree of depolarization and scattered-light intensity from these polarization components

[0039] moreover, the thing for which the filter used for for example, a deodorization machine, a dust catcher, etc. removes the large suspended particle of the path contained in sample air -- the side -- it becomes possible to discriminate a pollen grain child only by photo-electric-translation signal Sig.1 from the polarimetry section 28

[0040]

[Effect of the Invention] If the pollen detector concerning this invention is used, since the observation of a microscope which pretreatment of dyeing etc. becomes unnecessary like before and moreover requires skill is also unnecessary, anyone can measure a pollen grain child easily. Furthermore, since counting of the pollen grain child can moreover be carried out on real time in the place which should be measured, it becomes possible to obtain pollen information promptly.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the plan which fractured some pollen detectors concerning one example of this invention.
[Drawing 2] It is the P-P line cross section of drawing 1 .
[Drawing 3] the polarization intensity of the incidence polarization direction of forward-scattering light, and the side -- it is the circuit diagram showing the example of the distinction circuit which distinguishes a pollen grain child based on the polarization intensity of a right-angled direction in the incidence polarization direction of the scattered light
[Drawing 4] drawing showing an example of the photo-electric-translation signal with which (a) shows the polarization intensity of the incidence polarization direction of forward-scattering light, and (b) -- the side -- drawing showing an example of a photo-electric-translation signal which shows the polarization intensity of a right-angled direction in the incidence polarization direction of the scattered light, drawing showing the signal with which (c) appears in A points of drawing 3 , and (d) are drawings showing the signal which appears in B points of drawing 3
[Drawing 5] It is drawing showing the principle of the pollen detector of this invention.
[Drawing 6] It is a histogram showing the particle size distribution of the suspended particle in the atmosphere.
[Drawing 7] the side -- degree-of-depolarization Iver/Ipar It is a histogram showing the distribution of the suspended particle in the atmosphere at the time of taking on a horizontal axis.
[Drawing 8] the polarization intensity of the incidence polarization direction of forward-scattering light -- a horizontal axis -- the side -- it is drawing showing a distribution with the pollen at the time of taking degree of depolarization along a vertical axis, and sedimentation nature air dust

[Description of Notations]
11 -- Red light emitting diode
12, 15, 18 -- Lens
13, 14, 17 -- Polarizing filter
16 19 -- Photo transistor
21 -- Inhalation mouth
22 23 -- Heater
24 -- Optical trap
26 -- Polarization light source section
27 -- Front polarimetry section
28 -- the side -- the polarimetry section

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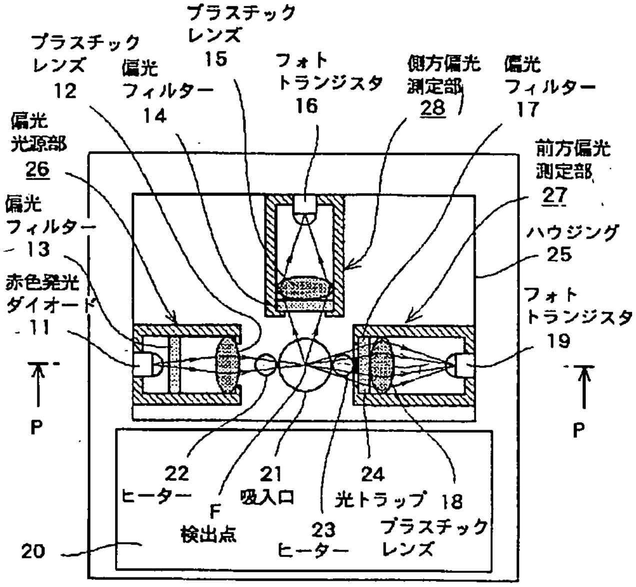
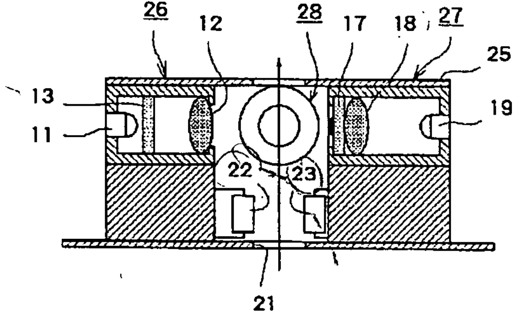
DRAWINGS

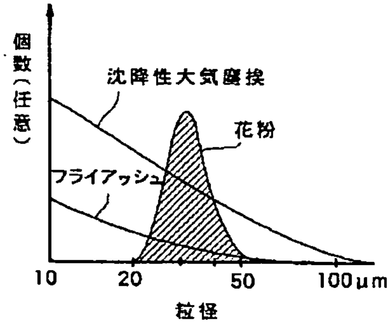
[Drawing 1]



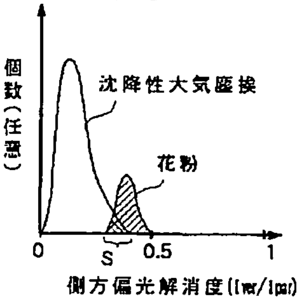
[Drawing 2]



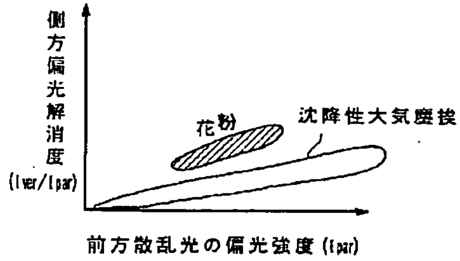
[Drawing 6]



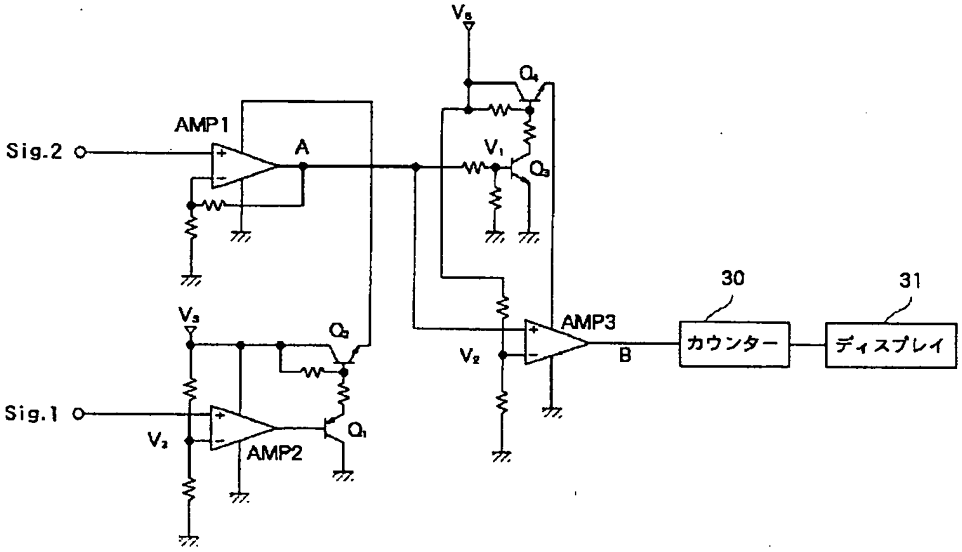
[Drawing 7]



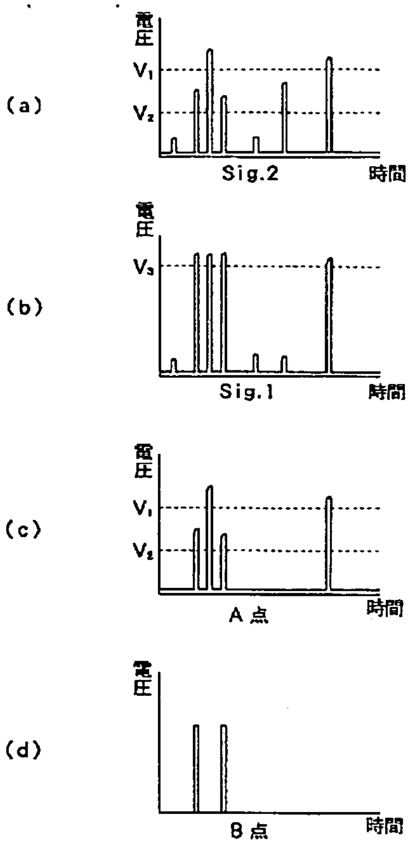
[Drawing 8]



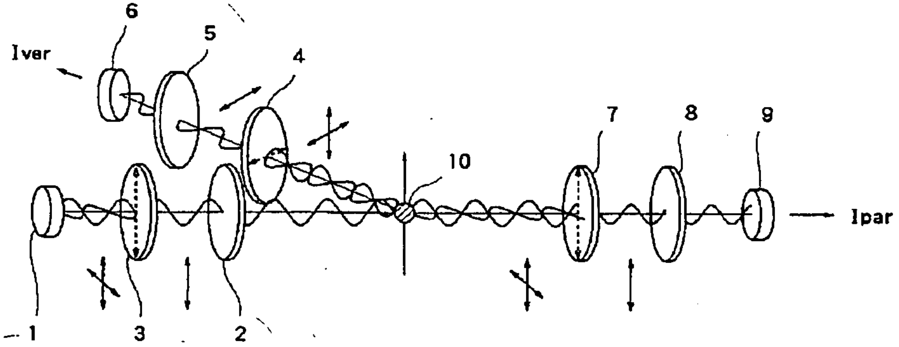
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]